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6. AUTHOR(S)

Dr. Ulf Balldin

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Division of Aviation Medicine
National Research Establishment
Box 13400
S-17290 Sundbyberg, Sweden

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REPORT OF G-PROTECTION PHYSIOLOGY RESEARCH RELATED TO EXTENDED COVERAGE G-TROUSERS WITH PRESSURE BREATHING ON HUMAN VOLUNTEERS UNDER G-LOADS ON THE HUMAN CENTRIFUGE AT AL/CFTF, BROOKS AFB, TEXAS DONE BY ULF BALLDIN, M.D., PH..D. , NATIONAL DEFENCE RESEARCH ESTABLISHMENT, SWEDEN DURING THE PERIOD APRIL 1, 1992 TO APRIL 14, 1993.

Analyses have been made of results of a former cooperative centrifuge study by USAF and Swedish Defence done at the AL/CFTF with Swedish fighter pilots as subjects. It showed that a pressure reduction to about 75% of the normally increased pressure could be done during gradual onset rate G-loads with the extended coverage anti-G trousers with assisted pressure breathing without compromising the G-tolerance. Further pressure reduction indicated a lower G-tolerance. During simulated aerial combat maneuvers the study showed a lower G-tolerance already with 75% reduction in pressure, also supported by changes in heart rate. The results are published in Aviation Space Environmental Medicine (1).

A follow up study, also with Swedish fighter pilots as subjects, showed similar results. The study also aimed at comparing the Swedish Tactical Flight Combat Suit (TFCS) with USAF COMBAT EDGE with ATAGS, both extended coverage anti-G trousers with pressure breathing during G. No statistically significant differences were found between the different equipment. HOWEVER, 90% of the subjects were capable of endure 60 s at

9 G with the TFCS with full pressure, 73% at reduced pressure and 60% wearing the COMBAT EDGE with ATAGS with full pressure. While reduced pressure in the extended coverage G-suit -- combined with positive pressure breathing -- may statistically affect G-tolerance, the effectiveness of these combined technologies provide pilots sufficient G-tolerance to meet operational requirements. Noteworthy among the simulated aerial combat maneuver G-profiles were 3 subjects who endured more than 9 mins of exposure before stopping; 1 subject completed 12.5 mins (35 cycles). Results of the study was presented at 1993 Aerospace Medical Association's annual scientific meeting in Toronto, Canada (2) and at the International Congress of Aviation and Space Medicine in Hamburg 1993 and were published in its proceedings (3, 4).

Other research involved development of a remote control of transcranial Doppler (TCD) probe during centrifuge exposures up to 9 +Gz. The Doppler probe and three electrical motors were mounted on a tightly fitted helmet. Remote control of these motors allows precise tilting and sliding of the probe at during G-exposures. Position of the probe at different G-levels are recorded when a good flow velocity signal is achieved. On succeeding G-exposures the probe is moved to the predicted positions for different G-loads when the G-load changes. With this device, blood flow velocity in the middle cerebral artery can be registered at G-loads up to 9 +Gz with increased accuracy. The device should be able to use in future acceleration physiology research both in basic and more applied studies of equipment development. The results of this development have been presented at SAFE Symposium 1993 and published in SAFE Journal (5). A computer program to automate the probe movement process is also under development.

Another cooperative project dealing with more basic acceleration physiology research involved echocardiographic assessment of right ventricular response following release of simulated +Gz stress using the lower body negative pressure technique together with LP Krock, NL Hopper, DA Ludwig and WG Squires. Still another project involved cerebral artery blood flow velocity changes following removal of presyncopal simulated high +Gz stress using similar G-simulation technique together with the same authors. The results of these studies are to be analyzed.

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